(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 127 505 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.08.2001 Bulletin 2001/35

(51) Int Cl.[7]: **A43B 7/08**

(21) Application number: **00830139.2**

(22) Date of filing: **28.02.2000**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

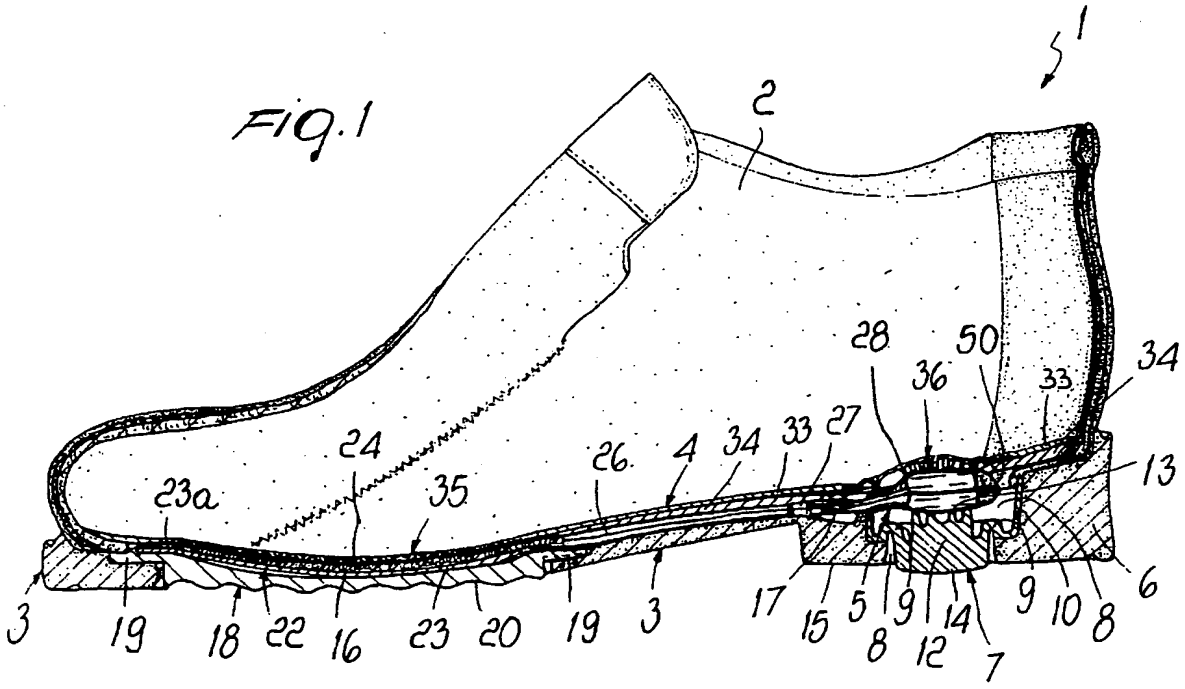
(71) Applicant: **STONEFLY S.p.A.**
31010 Fraz. Casella-Asolo (Treviso) (IT)

(72) Inventor: **Sartor, Adriano**
31044 Montebelluna (Prov.of Treviso) (IT)

(74) Representative: **Lanzoni, Luciano et al**
c/o BUGNION S.p.A.
Via G. Garibaldi n. 19
37121 Verona (IT)

(54) Forced air circulation shoe structure

(57) A forced air circulation shoe structure comprising an upper (2), a hull-like sole (3) and at least one pumping device for sucking in and expelling air, having at least one intake chamber (22) which is located at the ball portion of the sole (3) and receiving at least one pad element and communicates with the inside of the shoe (1) by means of a plurality of through holes or openings. The shoe structure has, at the intake chamber (22), at least one mat-shaped vapor-permeable portion (35) to allow the air forced by the pumping device to flow into or from the inside of the shoe (1).



EP 1 127 505 A1

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The present invention relates to a forced air circulation shoe structure.

[0002] Several examples of highly perspiratory or vapor-permeable shoes are currently commercially available. Such shoes are manufactured by using special vapor-permeable materials and manufacturing methods aimed at obtaining an inner healthy, hygienically clean and dry environment, particularly in shoes, ankle-high boots and knee-high boots, i.e., in those types of footwear in which the problem of foot perspiration is more heavily felt.

[0003] One of the proposed technical solutions provides for the adoption of a pumping device which is located in a suitable seat formed in a hull-like sole and capable of sucking moist and warm air, e.g. inside a shoe and expelling it outside, thus maintaining a conditioned and ventilated internal environment.

[0004] The pumping device can comprise an intake chamber located at the sole of the foot and provided with a plurality of through openings, through which any sucked air flows, in use, and a pumping chamber, which communicates with said intake chamber via a duct controlled by a one-way valve, is padded with a porous and flexible material, and is arranged to be alternatively compressed and expanded at each step performed by the user, thereby expelling air from, and sucking air into, the shoe, respectively.

[0005] The structure and the arrangement of the intake chamber and the pumping chamber inside the shoe may be such that the user, while walking, can operate the pumping device owing to the natural movement of his foot, since the foot itself first compresses the pumping chamber to expel warm and moist air previously accumulated inside it, by resting the heel of the foot onto the heel of the shoe while keeping the sole of the foot lifted, and then sucks the air from the inside of the shoe through the intake chamber, by lifting the heel of the foot and resting the sole of the foot.

[0006] Compression of pumping chamber during resting of the heel of the foot is currently achieved by means of an insert which is located at the heel of the shoe and cyclically applies first to said chamber a force from the heel of the shoe towards the inside of said shoe, thereby causing partial compression of said chamber, and then leaves it free to expand and regain its non-compressed shape.

[0007] A drawback of current technical solutions in the manufacture of shoes having vapor-permeable properties is that of ensuring beneficial effects limited in time in inner ventilation and conditioning. Intense and/or prolonged use of a shoe in fact usually entails rapid worsening in the vapor-permeable properties owing to deterioration and malfunctioning of the shoe components.

[0008] The main aim of the present invention is to provide a shoe or the like which is suitable for increasing the efficiency of said pumping device in order to achieve maximum internal ventilation and the best possible conditioning, thereby avoiding excessive and undesired foot perspiration, also for prolonged and particularly intensive use of said shoe.

[0009] Another object of the present invention is that the said structure of a shoe or the like is such as to offer, in addition to high vapor-permeability, maximum comfort and as much attractive styling.

[0010] Another object of the present invention is that the said structure of a shoe or the like comprises components which do not cause discomfort to the user's foot and whose operation does not produce unpleasant noise due to their mutual rubbing, especially after prolonged use of the shoe.

[0011] These and other objects which will become better apparent hereinafter are achieved by a forced air circulation shoe structure comprising an upper, a hull-like sole and at least one pumping device for sucking in and expelling air, having at least one intake chamber, which is located at the ball portion of said sole and receiving at least one pad element and communicates with the inside of said shoe by means of a plurality of through holes or openings, characterized in that it has, at said intake chamber, at least one mat-shaped vapor-permeable portion to allow air forced by said pumping device to flow into or from the inside of said shoe.

[0012] Advantageously, said shoe comprises an inner sole which can be placed on said pumping device and has, in use, said mat-shaped vapor-permeable portion arranged at the intermediate sole portion of said shoe.

[0013] Conveniently, said pumping device comprises at least one pumping chamber which is connected to said intake chamber and to the outside and can be arranged at the heel of said hull-like sole, and said inner sole is provided with compression means which can be placed on said pumping chamber and are arranged to pass alternatively from a working position, in which owing to the load applied thereto by the heel of the user's foot they compress said pumping chamber, to a resting position, in which said chamber is free to expand and regain its uncompressed shape.

[0014] Further aspects and advantages of the present invention will become better apparent from the following detailed description of some currently preferred embodiments thereof, given only by way of non-limitative examples with reference to the accompanying drawings, wherein:

Figure 1 is a sectional view of a shoe according to the invention, taken along a plane at right angle with, and parallel to, the longitudinal extension of the sole;

Figure 2 shows a plan view of an inner sole used in the shoe of Figure 1, seen from its bottom surface;

Figure 3 shows an enlarged-scale cross-section view of the vapor-permeable portion of the inner sole, taken along the line III-III of Figure 2;

Figure 4 is a partial sectional view on an enlarged

scale of an insert of the inner sole, taken along the line IV-IV of Figure 2;
Figure 5 shows a plan view of a pumping device adopted in the shoe of Figure 1;
Figure 6 is a sectional view of the pumping device, taken along the line VI-VI of Figure 5;
Figure 7 shows a schematic view of the shoe of Figure 1, while air is sucked in;
Figure 8 shows a schematic view of the shoe of Figure 1 while air is discharged outside; and
Figure 9 is a partial side elevation view of the rear portion of the shoe of Figure 1.

[0015] With reference to the above Figures, a shoe having a structure according to the invention is designated by the reference numeral 1 and comprises an upper 2, a hull-like sole 3 and an insole 4.

[0016] As shown in Figure 1, the sole 3 has, at the heel 6 thereof, an insert 7 made of plastic material which intercepts a through opening 8 formed beforehand in the heel 6. The insert 7, which is obtained e.g. by injection-molding, can be provided with a peripheral bellows portion 9 adhering to the internal surface 10 of the through opening 8. The body 12 of the insert 7 is thus supported by the peripheral portion 9 and delimited, in its resting position, by an upper end 13, which is slightly concave with respect to the inside of the shoe 1, and by a lower end 14, which is slightly convex and partly protrudes with respect to the lower surface 15 of the heel 6.

[0017] Every time a user performs a step while wearing the shoe 1, the insert 7 is first pushed upwards from its above described resting position, when the user applies all his weight to the heel 6, until its lower surface 14 becomes co-planar with the lower surface 15 of the heel 6. Subsequently, upon the heel 6 being lifted, the insert 7 returns to its resting position owing to its flexible peripheral portion 9, which forces it to return downwards and to protrude again from the lower surface 15 of the heel 6.

[0018] Moreover, the sole 3 may have, at its portion 16 where, in use, the foot of the user lies, a second insert 17 made of synthetic and flexible material 18 (shown in Figure 1), which is coupled to the sole 3 along one of its peripheral edges 19 and delimited in its lower region by an undulating lower surface 20 designed to increase the grip of the sole 3 on the ground 48.

[0019] Advantageously, a pumping device 21 is provided between the sole 3 and the inner sole 4 and arranged to suck air inside the shoe 1, which usually tends to be warm and moist, and to expel it outside, whereby keeping the internal environment of the shoe 1 ventilated and dry. As shown in Figure 5, the pumping device 21 comprises an intake chamber 22, which is designed to be superimposed, in use, on the portion 16 of the sole 3, and includes an external sheath 23, preferably made of polyurethane, containing a padding made of open-cell foamed material 24.

[0020] A plurality of through holes or openings 25 are preferably formed in the innermost portion 23a of the sheath 23 of the shoe 1, through which saturated air stored inside the shoe 1 is sucked in use. Said air sucked and stored inside the intake chamber 22 is conveyed into a duct 26, which is controlled by a one-way valve 27 designed to allow air to flow only in the direction indicated by arrow X.

[0021] Suction of air through the intake chamber 22 and the duct 26 is made possible owing to a pumping chamber 28, which by changing from a compressed condition, shown in Figure 8, to a non-compressed condition, as shown in Figure 7, generates inside it a sucking action that draws air from the inside of the shoe 1.

[0022] Advantageously, the pumping chamber 28 is superimposed, in use, on the upper end 13 of the insert 7, so that owing to its alternating movement at right angles to the heel 6 the insert 7 applies an alternating compression action upwards against the chamber 28, thereby alternatively causing compression and expansion thereof.

[0023] As shown in Figure 5, the pumping device 21 is finally provided with a one-way valve 29 which controls a discharge duct 17 and is suitable for discharging the air stored in the chamber 28, air flow being allowed only in the direction indicated by letter Y.

[0024] Figure 9 clearly shows the protrusion of the body 12 of the insert 7 from the lower surface 15 of the heel 6, and also illustrates the detail of the valve 29, which is preferably vented at the lateral surface 31 of the heel 6.

[0025] The inner sole 4, shaped as shown in Figure 2, can advantageously be coupled, in use, to the pumping device 21 and comprises an upper innermost layer 33 of the shoe 1, which is made of flexible material, e. g. leather or imitation of leather, a lower layer 34 preferably made of a relatively rigid material, e.g. cardboard, a vapor-permeable portion 35 which is located, in use, at the intake chamber 22 of the device 21, and compression means 36, advantageously confined in the region where the user's heel rests and designed to interact with the pumping chamber 28.

[0026] As is more clearly shown in Figure 3, the vapor-permeable portion 35 can advantageously comprise three layers 37, 38 and 39, which form a textile insert net-like structure forming a so-called "mat structure", in which the intermediate layer 38 is particularly flexible, since it has a lower specific density than the two outer layers 37 and 39, thereby enhancing the elastic properties of the vapor-permeable portion 35 and improving the comfort of the inner sole 4.

[0027] In order to allow air to pass from the inside of the shoe 1 to the pumping device 21, the vapor-permeable portion 35 can close a through opening 40 formed beforehand in the upper layer 33 of the inner sole 4. As shown in Figures 2 and 3, the vapor-permeable portion 25 is fixed to the upper layer 33 preferably by means of a stitched seam CA along its peripheral edge 35a.

[0028] Figures 2 and 3 also illustrate how the lower

layer 34 affects preferably only the portion of the inner sole 4 on which the heel and the central portion of the foot act in use, since the same is designed to provide a resting surface as uniform and even as possible, whereby compensating for the discontinuities in the underlying hull-like sole 3.

[0029] The lower layer 34 which is made of relatively rigid material can thus end adjacent to the vapor-permeable portion 35 that is kept permanently in contact with the layer 33 of flexible material, e.g. by means of stitched seams CA, thus ensuring that the inner sole 4 is waterproof.

[0030] Compression means 36 preferably comprises a membrane 41 made of synthetic material, e.g. thermoplastic polyurethane, which closes an opening 42 formed beforehand in the upper layer 33 of the inner sole 4 and having a peripheral edge 43 secured between the upper layer 33 and the lower layer 34 of the inner sole 4.

[0031] The membrane 41 shown in Figure 4 delimits a middle portion 45 which in its non-compressed position takes a domed shape forming an upper surface 46 that is convex with respect to the inside of the shoe 1, and a lower surface 47 concave with respect to the heel 6.

[0032] Advantageously, between the peripheral edge 43 and the middle portion 45, the membrane 41 comprises peripheral return means 48 which are resiliently flexible, bellows-shaped and suitable for facilitating compression of the membrane 41 in use and assisting it returning to its non-compressed position.

[0033] A plurality of pins 47 are preferably provided on the lower surface 46 of the middle portion 45 of the membrane 41 and longitudinally extend at right angles to the inner sole 4 so as to face the pumping chamber 28, thereby applying thereto, in use, an alternating compression force directed from the inside of the shoe 1 towards the heel 6.

[0034] Figures 7 and 8 are diagrammatic views of two different situations which respectively correspond to the resting condition and to the working condition of the membrane 41. When the user lifts the heel 6 from the ground, the membrane 41 and the insert 7 of the heel 6 move mutually apart in the directions of the arrows Z' and Z", respectively, thereby allowing the pumping chamber 28 to expand. The expansion of the chamber 28 generates inside it a suction action which draws air from the inside of the shoe 1 through the one-way valve 27, while the valve 29 remains closed.

[0035] In its working condition, i.e., when the heel 11 of the foot applies the entire weight of the user onto the heel 6 of the shoe, the membrane 41 advantageously moves downwards in the direction of the arrow K' and simultaneously the insert 7 of the heel 6 rises as shown by the arrow K". As shown in Figure 8, in this case the chamber is suddenly compressed by the pins 47 and by the insert 7, which causes the air previously stored inside the chamber 28 to be expelled through the valve 29, the valve 27 remaining closed. Cooperation of pins 47 and body 12 of the insert 7 thus allow complete compression of the chamber 28 to take place, which means to displace the maximum volume of air per cycle.

[0036] Since each step made by a user corresponds to a complete cycle of compression and expansion of the chamber 28, the chamber 28 can be lined with a jacket 50 of wear-resistant and sound-deadening fabric in order to prevent repeated rubbing of the pins 47 against said chamber from causing, in the long run, both wear of the surfaces in contact and unpleasant noise which is repeated at each step.

[0037] The shoe according to the present invention is susceptible to numerous modifications and variations within the scope as defined by the appended claims.

[0038] Of course, the shoe structure according to the present invention may be provided with a pumping device comprising intake and pumping units, that can include various technical solutions. The pumping chamber 28 can be replaced, e.g., by a pump of suitable power and size, powered by a battery and capable of operating independently in order to alternately suck into and expel air from the inside of the shoe 1, while occupying a small space at the heel 6 of the shoe 1. Likewise, also the intake chamber 22 may be different from that described above, so long as it is in any case coupled to a vapor-permeable portion secured thereto or belonging to an overlying inner sole and allows air to flow from the inside of the shoe 1 to the intake unit and then to be discharged outside.

[0039] It is possible to use, inside the shoe 1, an inner sole 4 (not shown in the Figures) whose lower layer is made of relatively soft material by injection-molding and extends throughout the entire lower surface of the upper layer 33 except at the opening 40 and thus at the vapor-permeable portion 35 and the insert 36. In this case, in order to obviate the discontinuities of the underlying sole 3, the inner sole 4 is advantageously thicker where the heel and the central portion of the foot will rest in use.

[0040] Materials used and the dimensions may be various according to requirements.

[0041] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. A forced air circulation shoe structure comprising an upper, a hull-like sole and at least one pumping device for sucking in and expelling air, having at least one intake chamber which is located at the ball portion of said sole and receiving at least one pad element and communicates with the inside of said shoe by means of a plurality of through holes or

openings, characterized in that it has, at said intake chamber, at least one mat-shaped vapor-permeable portion to allow the air forced by said pumping device to flow into or from the inside of said shoe.

2. The shoe structure according to claim 1, characterized in that it comprises an inner sole arranged on said pumping device and having, in use, said mat-shaped vapor-permeable portion located at said intake chamber.

3. The shoe structure according to claim 1 or 2, characterized in that said pumping device comprises at least one pumping chamber which is connected to said intake chamber and to the outside and can be arranged at the heel of said hull-like sole, and in that said inner sole is provided with compression means which are arranged on said pumping chamber and designed to alternate from a working position, in which owing to the load applied thereto by the heel of the user's foot said pumping chamber is compressed, to a resting position, in which said pumping chamber is free to expand and regain its uncompressed shape.

4. The shoe structure according to claim 3, characterized in that said compression means comprises at least two portions, the first one of which is designed to interact with the user's foot and the other is suitable for resting alternately, in use, on said pumping chamber.

5. The shoe structure according to claim 4, characterized in that said first portion comprises at least one membrane having a peripheral edge rigidly coupled to said inner sole and a middle portion having, when at rest, a domed shape thereby delimiting an upper surface which is convex with respect to the inside of said shoe and raised with respect to said inner sole, and a lower surface which is a concave with respect to said hull-like sole.

6. The shoe structure according to claim 4 or 5, characterized in that said membrane comprises return means which lie between said peripheral edge and said middle portion, thereby allowing said middle portion of said membrane to cyclically regain said uncompressed domed configuration after being deformed by compression by the heel of the user's foot.

7. The shoe structure according to claim 6, characterized in that said return means comprise at least one peripheral portion of said membrane which is flexible and bellows-shaped.

8. The shoe structure according to any one of the preceding claims, characterized in that said second portion of said membrane comprises a plurality of pins protruding from said lower surface of said membrane and longitudinally extending, in use, transversely to said sole.

9. The shoe structure according to claim 8, characterized in that said pins are confined at said middle portion of said membrane, thereby applying to said pumping chamber a localized compression which is directed from the inside of said shoe toward said sole.

10. The shoe structure according to any one of the preceding claims, characterized in that said hull-like sole comprises, at least at the heel thereof, an insert made of a flexible material and suitable for applying to said pumping chamber, in use, an alternating compression force which is directed toward the inside of said shoe, whereby alternatively compressing said pumping chamber and regaining said uncompressed domed configuration of said pumping chamber.

11. The shoe structure according to any one of the preceding claims, characterized in that it comprises means for covering said pumping chamber whereby preventing the surfaces in contact from wearing and avoiding unpleasant noise from being caused by said pins and said insert rubbing against said pumping chamber.

12. The shoe structure according to claim 11, characterized in that said covering means comprises a jacket made of wear-resistant and sound-deadening fabric suitable for being at least partly wrapped around said pumping chamber.

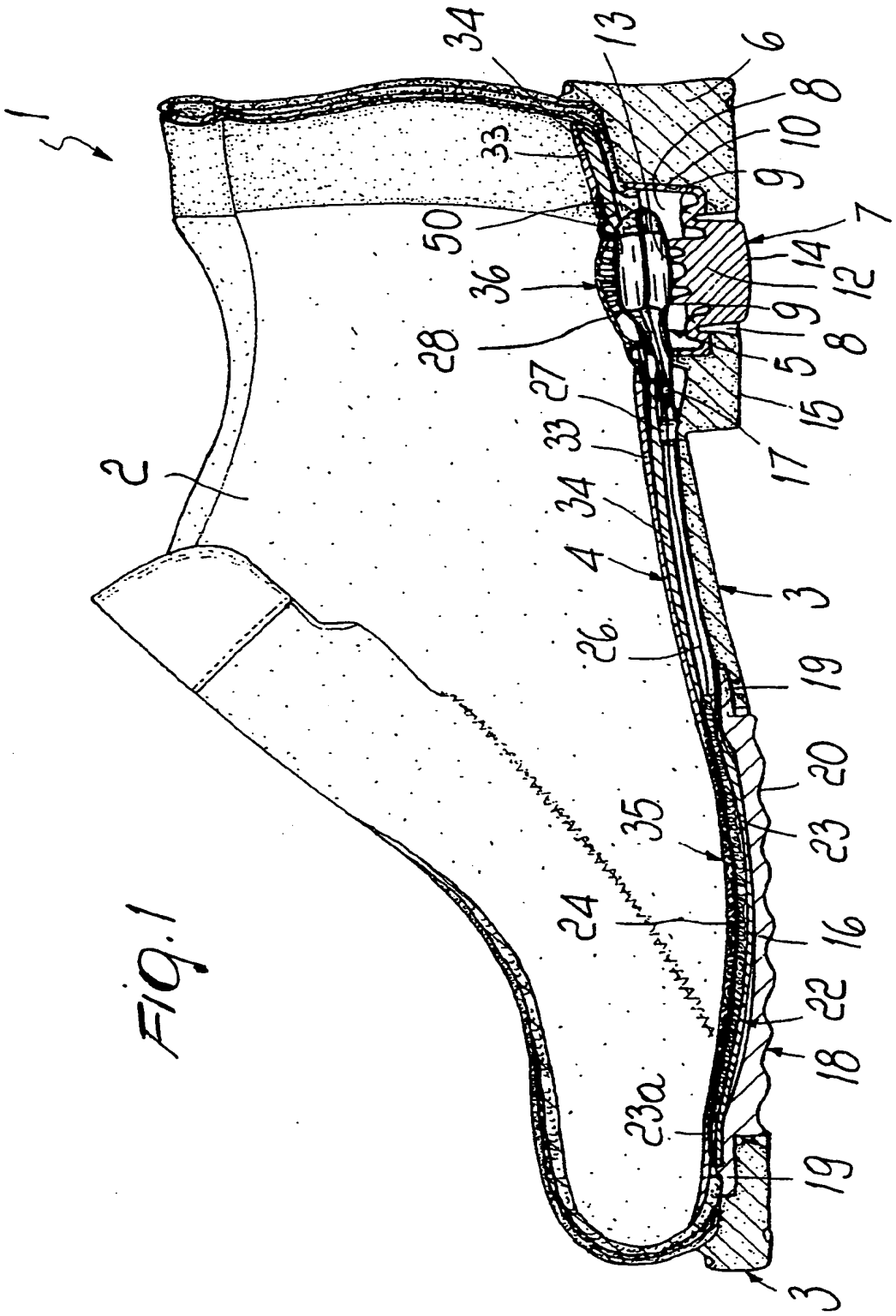

1
2
3
4
5
6
7
8
9
10
12
13
14
15
16
17
18
19
20
22
23
23a
24
26
27
28
33
34
35
36
50

Fig.1

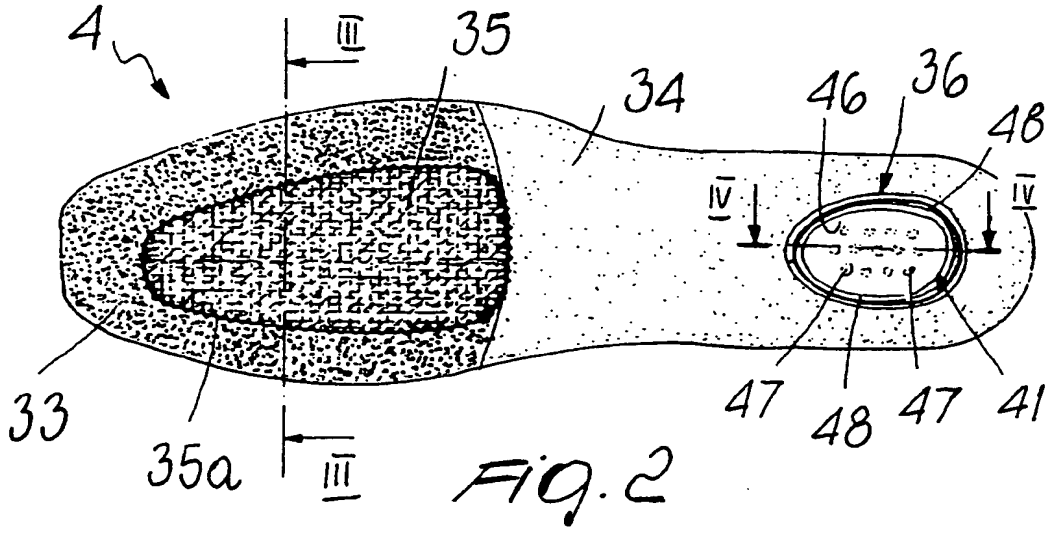


FIG. 2

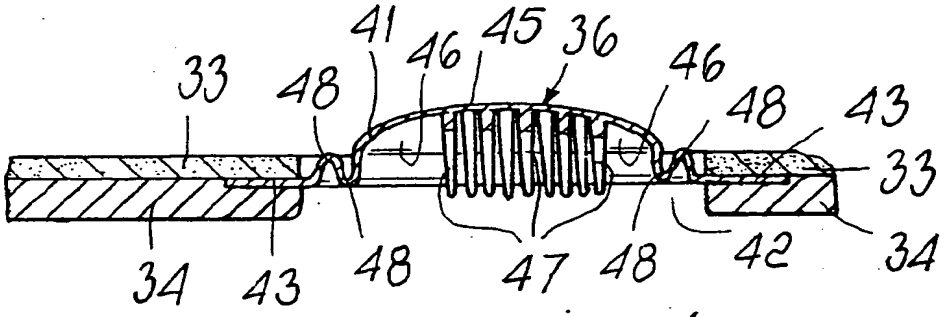


FIG. 4

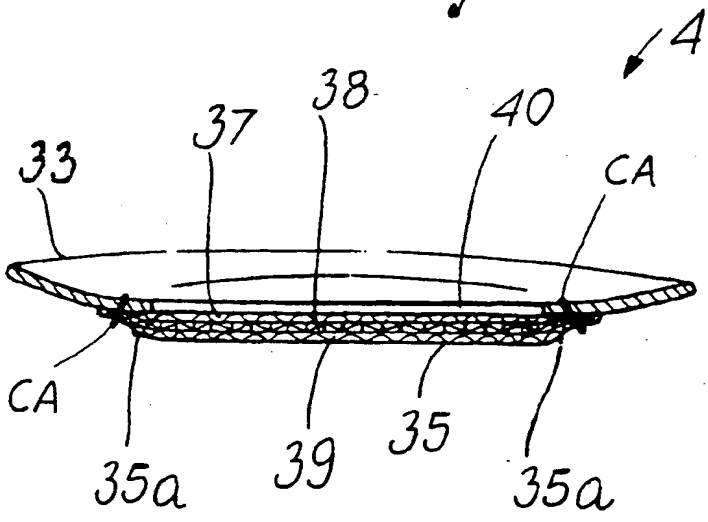


FIG. 3

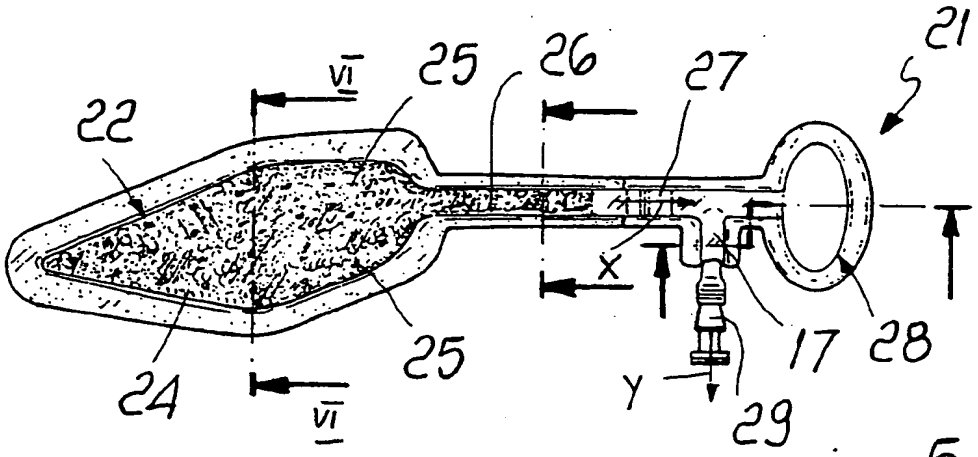


FIG. 5

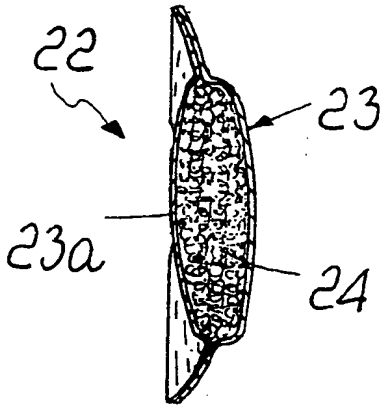


FIG. 6

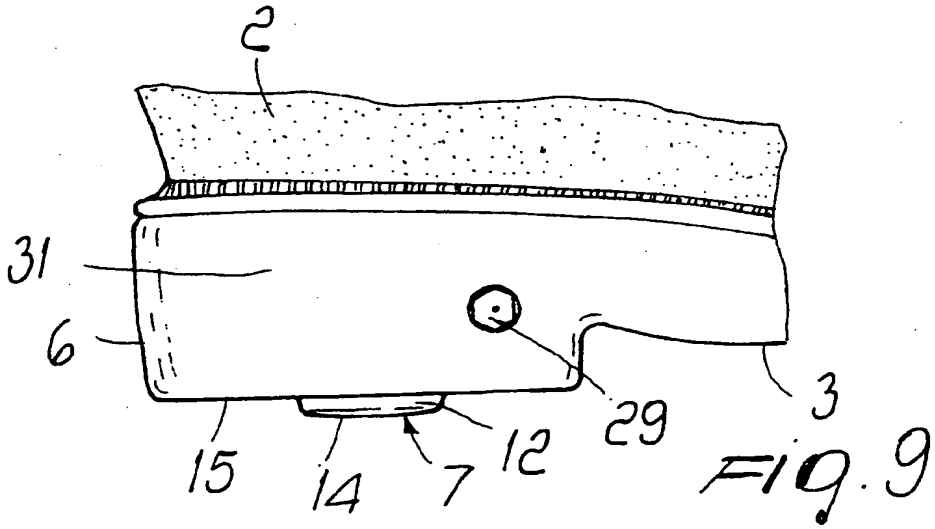


FIG. 9

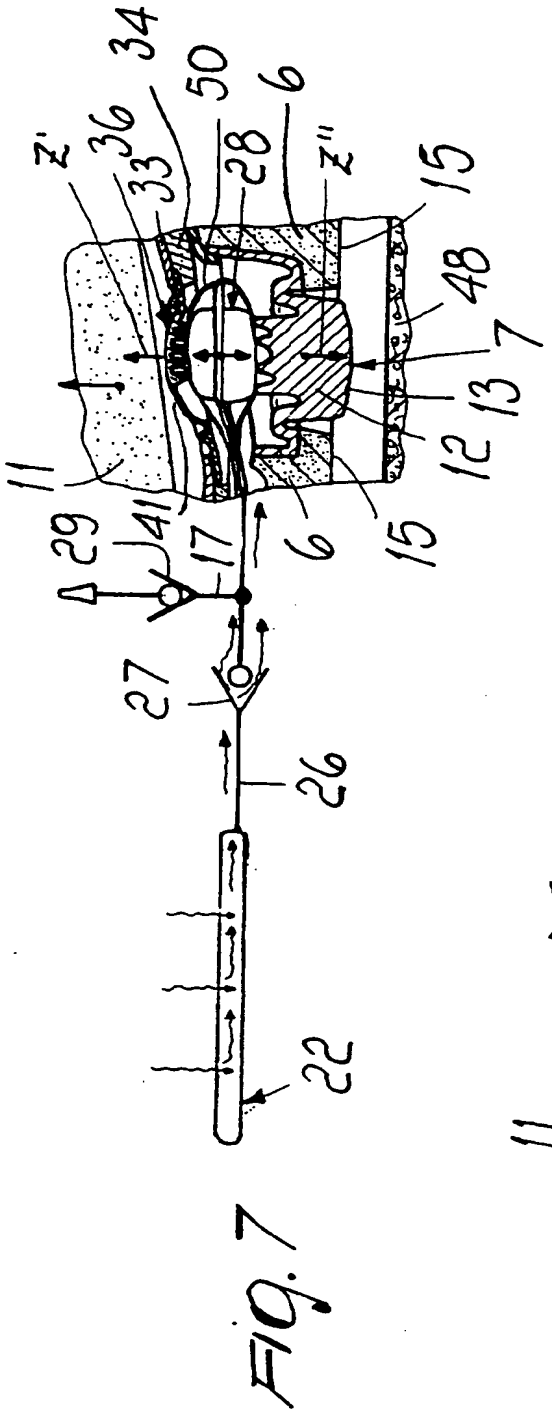

Z'
36
33
34
50
28
6
Z"
15
48
7
13
12
11
29
41
17
6
15
27
26
22

Fig. 7

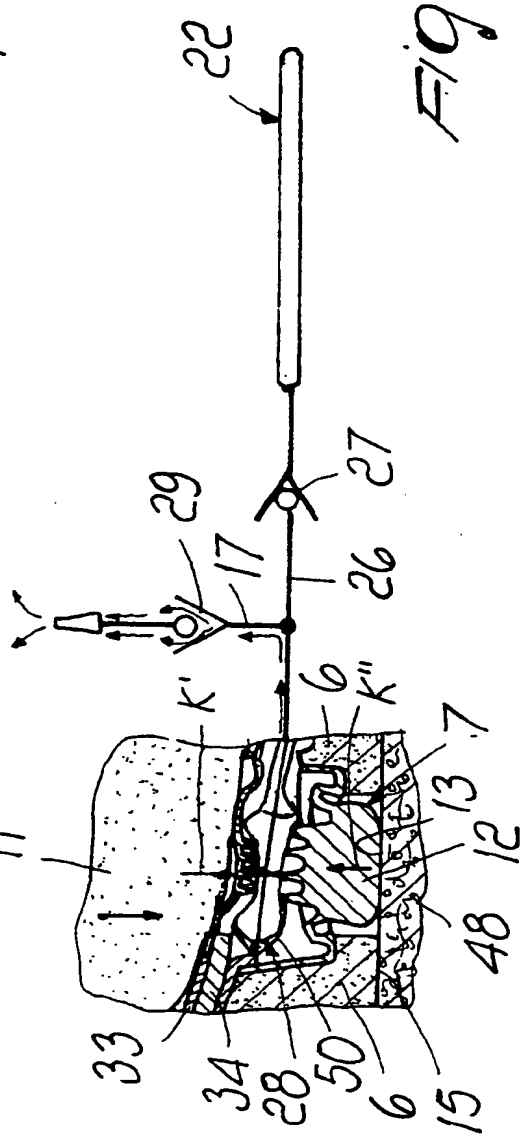

22
27
29
17
26
K'
K"
6
7
13
12
11
48
33
34
28
50
6
15

Fig. 8

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 83 0139

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	GB 2 247 391 A (TRIPLE THREE LEISURE LIMITED) 4 March 1992 (1992-03-04) * column 3, paragraph 2 * * column 4, paragraph 2 * * column 5, paragraph 3 * * column 6, line 1 - line 16 *	1-3,10	A43B7/08
X	EP 0 916 274 A (FIORANELLI RENATO ;MARIOTTI GIANFRANCO (IT)) 19 May 1999 (1999-05-19) * paragraphs '0020!,'0021! *	1,2,10	
A	BE 550 079 A (R THIEBAUT) 31 August 1956 (1956-08-31) * page 6 - page 7 *	3-9	
X	EP 0 624 322 A (FUKUOKA CHEMICAL INDUSTRY CO L) 17 November 1994 (1994-11-17)	1-3	
A	* claims *	4,5	
X	US 5 860 225 A (O'DWYER JAMES M) 19 January 1999 (1999-01-19) * column 3, line 1 - line 8 *	1,11,12	TECHNICAL FIELDS SEARCHED (Int.Cl.7) A43B
A	EP 0 275 644 A (JAPAN GORE TEX INC) 27 July 1988 (1988-07-27) * abstract *	1,2	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	7 July 2000	Claudel, B

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 00 83 0139

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

07-07-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2247391 A	04-03-1992	NONE	
EP 0916274 A	19-05-1999	IT B0970668 A IT B0970719 A	11-05-1999 16-06-1999
BE 550079 A		NONE	
EP 0624322 A	17-11-1994	JP 7023802 A CN 1100615 A DE 69404737 D DE 69404737 T ES 2106466 T KR 9709625 B US 5505010 A	27-01-1995 29-03-1995 11-09-1997 19-03-1998 01-11-1997 17-06-1997 09-04-1996
US 5860225 A	19-01-1999	US 5606806 A	04-03-1997
EP 0275644 A	27-07-1988	GB 2200031 A	27-07-1988

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82